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TOXICOLOGICAL STUDIES ON THE EFFECTS OF INSECT GROWTH REGULATORS SYNERGISED WITH SURFACTANT AGAINST SOME DEVELOPMENTAL STAGES OF MUSCA DOMESTICA

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ABSTRACT

Early 3rd larval instar of Musca domestica was treated with two insect growth regulators (IGRs) namely, ABY SIR 8514 and SIR 81514 at doses of 20, 40, 60, 80 and 100 ppm and surfactant, Tween 80 at concentration of 2% were tested. Results evaluated the effect of synergism between IGRs and surfactant. Our results clearly indicated that all treatments caused a significant effect on the percentage of larval mortality. On the other hand, no significant effect on mortality and duration of pupal stage was detected and there is no effect on mating behaviour of the resulting adults. Our results clearly indicated that there is a pronounced reduction in the total out put of eggs deposited per female.

On comparing the effect of IGRs and IGRs with surfactant, it was clear that synergistic effect

between the IGRs and Tween 80 induced an increase in the percentage mortality of larvae, pupae and resulting adults. Longevity as parameter of resulting females resulting from treated as 3rd larval instar with IGRs with surfactant was shorter than those treated with IGRs alone. Reducing fecundity of the resulting females was dose dependant.

INTRODUCTION

The search for new compounds with satisfactory properties concerning their effects on the target pests as well as on the environment. It is necessary to find new sources for pesticide production. Accordingly, attension has been given recently to synergistic effect between IGRs and other chemical compounds such as surfactants which seem to have a greate value in controlling M. domestica. The present study deals with the effect of IGRs with surfactants as synergist on early 3rd larval instar of M. domestica.

MATERIALS AND METHODS

Susceptible strain of M. domestica which was maintained in the laboratory of Entomology department, Faculty of science, Benha Branch, Zagazig Unicersity, Egypt. This strain was regarded as susceptible to organophosphorous insecticides. Rearing insects was adopted according to technique described by **Busvine (1962),** under laboratory conditions 27 ± 2°C and 60 ± 2% RH. Insect growth

regulators used were: BAY SIR 8514 [1-4- (trifluoromethoxy phenyl) -3- (2-chlorobenzoyl)- urea] and SIR 8514 [2-choro-N-} [4- (trifluoromethoxy phenylamino)- carbonyl)}-benzamid]. BAY SIR 8514 was dissolved in acetone where SIR 8514 was dissolved in water. They were used at concentrations of 20, 40,60, 80 and 100 ppm. They were mixed with larval medium. Mortality was counted daily for 3 weeks of treatments. Malformed individuals of treated and control larval groups were recorded. Female fecundity was also determined. Groups of 15 newly emerged females and males were treated topically with doses of 20,40,60,80 and 100 ppm IGRs. These doses were also mixed with tween 80 at concentration of 2%. The percentage of adult mortality and female fecundity were calculated, as well as egg laying rhythm and duration. All data were statistically corrected according to **Abbott's Formula (1925).**

RESULTS AND DISCUSSION

1- Effects of BAY SIR 8514 and its mixture with Tween 80 on the early 3rd larval instar of Musca domestica.

Results in table (1) show that, the IGR gave a considerable high percentage of larval mortality after 24, 48 and 72 hrs of application. It increased as the time and dose were increased. The maximum value of mortality (81.33%) at dose of 100 ppm after 72 hrs. Pupal mortality was also showed dosage dependant, it increases with the increase of dose. Percentage of pupal mortality was 17.33% at 100 ppm.

It is clear from data presented in table (2) that there is no relationship between the percentage of malformed pupae and the dosage used. The malformed pupae failed to emerge from pupal skin. Larval duration showed insignificant decreasing as IGR dosage was increased. Also IGR had no significant effect on the pupal duration. While the percent of adult emergence was decreased with increasing the applied dosage to reach 1.33% at (100 ppm) as compared with control (98.66%). IGR had a slightly effected the production of malformed adults.

Female fecundity was highly affected by IGR, it decreased with increasing dosage. This value was 36.02 eggs/female at dose of 100 ppm as compared with (117.61) egg/female in the control group. IGR had a marked effect on egg hatchability. Refuced fecundity and fertility can be induced either directly by inhibition or distortion of ovarian development or indirectly by reducing the feeding ability. Similar results were obtained by other authors, ***Nicolas and John (1976), Rembold and Sieber (1981) and Hassan (1990).***

Data presented in Table (2) show the effect of IGRs when it was mixed with Tween 80. It is quite clear that the percentage of larval mortality with IGR and surfactant are not greater than those obtained when treated alone. Tween 80 might be enhancing the translocation of IGR. It appeared that the surfactant either affected the percentage of IGR into cuticle or affected the uptake of IGR into the larva. These results were in agreement with that obtained by ***(Mattson and Taft 1964 and Mesbah et al., 1982).***

2- Effect of SIR 8514 and its mixture with Tween 80 on the early 3rd larvalinstar of M. domestica:

SIR 8514 was applied by dipping technique method on early 3rd larval instar of M. domestica in larval food media treated with different dosages of 20,40, 60, 80 and 100 ppm. Table (3) shows that the percentage of larval mortality was inceased with the increasing of the dose as well as the exposure period. It reached a maximum value of 18.67% at the higher dosage of 100 ppm. Pupal mortality was also dosage- dependant. It increased with the increasing of the dosage to reach about 35.1 at dosage of 100 ppm. The high degree of abnormalities has become able to be seen at lower dosage. Complete inhibition of adult emergence from the malformed pupae was observed.

Time required to complete larval development after treatment with SIR 8514 was decreased from 2.74 days at control group reached its minimum level of 1.74 days in the case of treated larvae with dosage of 100 ppm. This decrease in larval duration was significant at doses of 20, 40 and 60 ppm and highly significant at dosage of 100 ppm. On the other hand, pupal duration was not affected by SIR 8514. Adult emergence was highly affected, it reached 56.00% at the higher dose of 100 ppm. There is no effect on mating behaviour. However, fecundity was highly affected at all higher dosages, being 36.3 eggs/female at 100 ppm as compared with (117.61) eggs/female in the control group. Our results agree with the findings of ***Conhn and Marks (1979).***

Results in Table (4) concerning the synergistic action of SIR 8514 doses of (20,40,60,80 and 100 ppm) with Tween 80 at concentration of 2%. In present study the larvicidal activity of the tested IGR has been greatly increase as a result of surfactant, Tween 80 as a synergistic agent to IGR, improved its toxic efficiency and lowered the doses to be used.. These results are agreed with the findings of ***Wolfenbrager and Holscher (1967); Meshab et al. (1982) and Hussein (1991)***

3- Effect of BAY Sie 8514 and SIR 8514 alone or with Tween 80 on the biological aspects of adult stage of Musca domestica.

IGRs with surfactant (2%) were topically applied on the abdominal sternites of the newly emerged adults of M. domestica.

Results in the table (5) reveal a significant effect of IGRs alone or with surfactant on adult mortality especially at 100 ppm. It is clear that the longevity of treated females was shorter than males. Both sexes are dose-dependant. It reached then minimum values of 10.6 and 10.5 days for females, and 12.4 12.1 days for males treated with 100 ppm of IGRs and IGRS with surfactant, respectively. IGRs Alone or mixed with surfactant are shortened the oviposition period, to 3.6 and 3.7 days, respectively, when 100 ppm. was used. The reduction in oviposition period was also significant at doses of 20 and 40 ppm, however, it was highly significant at dose of 60 ppm. and very highly significant at doses of 80 and 100 ppm.

Both preoviposition and oviposition periods are dose-dependant. Fecundity was highly reduced being 39.14 and

35.12 eggs at a dose of 100 ppm for the two IGRs, respectively. It is generally believed that IGR synergist may inhibit the detoxification process ***(Butler 1974),*** he also demonstrated that the synergistic effect observed with different adjuvants with IGRs could increased the properties of cuticle permeability. However, the synergistic action of the surfactants may be attributed as, mixing the surfactant with IGRs and may create a suitable internal condition for the action of IGRs.

Table (1): Effect of BAY SIR 8514 on the development of early 3rd larval instar of Musca domestica.

Treatments of IGR / Observations	Control	20 ppm	40 ppm	60 ppm	80 ppm	100 ppm
% corrected larval mortality after 24hrs	0.00	29.33	32.00	34.66	46.66	56.00
% corrected larval mortality after 48hrs	0.00	42.67	46.66	52.00	61.33	73.33
% corrected larval mortality after 27hrs	0.00	45.33	50.66	58.66	69.33	81.33
% Pupal mortality	1.33	12.00	13.33	14.66	16.00	17.33
% Deformed pupae	0.00	10.66	12.00	10.66	10.66	12.00
Larval durations (days) ± S.E	3.66 ± 0.213 *	3.56 ± 1.231 *	3.49 ± 1.28 *	3.38 ± 2.35 **	3.31 ± 1.213 *	3.18 ± 2.31 **
Pupal duration in (days) ± S.E	4.30 ± 1.53 *	4.23 ± 0.18 *	4.22 ± 2.31 *	4.18 ± 1.28 *	4.06 ± 0.45 *	3.99 ± 0.55 *
% Adult emergence	98.66	42.66	36.00	26.66	14.66	1.33
% Deformed adults	0.00	5.33	4.00	2.66	4.00	0.00
Mean no. of eggs laid/female ± S.E.	117.61 ± 2.31 *	85.32 ± 1.38 *	66.83 ± 0.45 *	58.50 ± 2.351 *	46.90 ± 2.01 *	36.02 ± 1.21 ***

* Significant. ** Highly significant *** Very highly significant

Table (2): Effect of larval treatment with a mixture of BAY SIR 8514 and Tween 80 (2%) on some biological aspects of M. domestica.

Treatments of IGR / Observations	Control	20 ppm	40 ppm	60 ppm	80 ppm	100 ppm
% corrected larval mortality after 24hrs	0.00	28.57	27.14	37.14	45.71	64.28
% corrected larval mortality after 48hrs	0.00	38.57	37.5	55.50	57.13	77.14
% corrected larval mortality after 27hrs	0.00	48.1	49.99	55.85	62.85	77.14
% Pupal mortality	1.33	10.66	12.00	13.33	16.00	17.33
% Deformed pupae	0.00	0.00	0.00	5.21	1.33	2.66
Larval durations (days) ± S.E.	3.5 ± 0.213 *	3.02 ± 1.231 *	3.0 ± 1.28 *	4.41 ± 2.35 **	3.08 ± 1.213 *	2.87 ± 2.31 **
Pupal duration in (days) ± S.E.	4.47 ± 1.53 *	4.1 ± 0.18 *	4.1 ± 2.31 *	3.33 ± 1.28 *	4.41 ± 0.45 *	4.41 ± 0.55 *
% Adult emergence	92	36.66	34.66	21.3	14.66	4.0
% Deformed adults	0.00	0.00	0.00	5.33	2.66	1.33
Mean no. of eggs laid/female ± S.E.	93.60 ± 2.31 *	78.17 ± 1.38 *	73.18 ± 0.45 *	62.40 ± 2.351 *	56.02 ± 2.01 *	49.31 ± 1.21 ***

* Significant
** Highly significant.
*** Very highly significant.

Table (3): Effect of larval treatment with a mixture of SIR 8514 on some biological aspects of M. domestica.

Treatments of IGR / Observations	Control	20 ppm	40 ppm	60 ppm	80 ppm	100 ppm
% corrected larval mortality after 24hrs	0.00	4.00	6.66	8.00	9.33	13.33
% corrected larval mortality after 48hrs.	0.00	6.66	9.33	10.66	14.66	18.67
% corrected larval mortality after 27hrs.	1.33	12.00	18.6	22.1	28.66	34.3
% Pupal mortality	0.00	12.00	17.33	20.00	22.66	35.1
% Deformed pupae	0.00	2.04	9.33	12.00	5.33	5.33
Larval durations (days) ± S.E.	2.47 ± 0.213 *	4.49 ± 1.231 *	1.97 ± 1.28 *	1.86 ± 2.35 **	1.81 ± 1.213 *	1.74 ± 2.31 **
Pupal duration (days) ± S.E.	4.5 ± 1.53 *	3.4 ± 0.18 *	4.49 ± 2.31 *	4.40 ± 1.28 *	4.40 ± 0.45 *	4.40 ± 0.55 *
% Adult emergence	98.66	81.33	73.33	69.33	62.66	56.00
% Deformed adults	0.00	17.33	14.66	13.33	14.66	13.33
Mean no. of eggs laid/female ± S.E.	117.61 ± 2.31 *	79.68 ± 1.38 *	87.61 ± 0.45 *	72.76 ± 2.351	60.18 ± 2.01 *	36.30 ± 1.21 ***

* Significant.
** Highly significant.
*** Very highly significant.

Table (4): Effect of SIR 8514 synergised with Tween 80 at concentration of 2% on some biological aspects of M. domestica.

Treatments of IGR / Observations	Control	20 ppm	40 ppm	60 ppm	80 ppm	100 ppm
% corrected larval mortality after 24hrs	0.00	4.0	5.33	6.66	8.0	9.33
% corrected larval mortality after 48hrs	0.00	5.33	8.0	10.66	12.0	14.66
% corrected larval mortality after 72hrs	1.33	9.2	11.1	13.5	15.2	20.1
% Pupal mortality	0.00	10.66	12.0	14.66	18.66	20.6
% Deformed pupae	0.00	12.06	12.0	10.66	6.66	4.0
Larval durations (days) ± S.E.	2.49 ± 0.213 *	2.90 ± 1.231 *	1.26 ± 1.28 *	1.63 ± 2.35 **	1.55 ± 1.213 *	1.01 ± 2.31 **
Pupal duration in (days) ± S.E	4.79 ± 1.53 *	4.9 ± 0.18 *	4.83 ± 2.31 *	4.8 ± 1.28 *	4.85 ± 0.45 *	4.86 ± 0.55 *
% Adult emergence	98.66	84.00	80.00	74.66	70.66	62.66
% Deformed adults	0.00	17.33	16.00	17.33	13.33	12.0
Mean no. of eggs laid/female ± S.E.	93.60 ± 2.31 *	77.35 ± 1.38 *	61.71 ± 0.45 *	55.00 ± 2.351 *	40.60 ± 2.01 *	30.23 ± 1.21 ***

* Significant
** Highly significant.
*** Very highly significant.

Table (5): Effect of larval treatment with IGR (BAY SIR 8514 or SIR 8514) with surfactant on adult stage of M. domestica.

Treatments of the two IGRs	Tween	80 2%										
Observations	Control		20 ppm		40 ppm		60 ppm		80 ppm		100 ppm	
	A*	B**	A*	B**	A*	B**	A*	B**	A*	B**	A*	B**
% corrected adult mortality after 4 days	0.00	0.00	20.0	18.1	29.0	32.00	32	36.1	35.0	40.1	45	44.2
Longevity of males days ± S.E.	15.8 ± 1.21	14.8 ± 1.35	15.8 ± 2.0	16.1 ± 1.7	15.6 ± 0.53	13.1 ± 0.45	15.6 ± 1.96	11.1 ± 0.98	14.2 ± 0.36	12.1 ± 1.32	12.4 ± 0.19	12.1 ± 0.25*
Longevity of females days ± S.E.	16.2 ± 1.5	15.9 ± 1.3	15.00 ± 0.98	15.00 ± 0.96	15.00 ± 0.45	14.2 ± 0.61	14.4 ± 1.72	12.1 ± 1.86	14.00 ± 1.2	9.1 ± 0.97	10.6 ± 0.96	10.0 ± 1.0**
Pre-oviposition period days ± S.E.	4.00 ± 1.5	4.1 ± 1.3	9.4 ± 0.97	9.1 ± 1.35	5.00 ± 2.1	5.1 ± 1.5	6.0 ± 0.97	6.0 ± 0.45	6.00 ± 1.5	6.2 ± 1.0	7.0 ± 2.3	6.7 ± 1.7*
Oviposition period days ± S.E.	11.3 ± 1.3	11.1 ± 0.45	11.00 ± 0.96	11.03 ± 0.18	9.30 ± 0.45	9.0 ± 0.36	8.3 ± 1.82	8.1 ± 1.21	7.4 ± 1.0	6.5 ± 0.97	3.60 ± 1.2	3.7 ± 0.35***
Post-oviposition period days	1.00 ± 0.12 *	1.00 ± 0.13*	1.00 ± 0.15*	1.3 ± 0.18*	1.00 ± 0.0	1.3 ± 1.18	1.00 ± 0.0	1.00 ± 0.0	1.00 ± 0.0	1.00 ± 0.0	1.00 ± 0.0	1.00 ± 0.0
Egg laying rhythm	7.00 1.21	6.66 0.98	6.0 0.86	5.9 1.35	6.00 1.0	6.1 0.96	5.00 1.35	4.9 0.97	4.00 1.23	4.1 1.3	4.00 1.5	4.0 0.97*
Mean No. of eggs laid female ± S.E.	117.61 ± 2.35	117.61 ± 1.73	99.8 ± 2.9	93.4 ± 1.36	87.9 ± 1.67	85.0 ± 2.53	75.11 ± 1.51	70.1 ± 2.3	42.5 ± 1.7	35.2 ± 0.98	39.14 ± 0.72	35.2 ± 1.4**

A* : BAY SIR 8514 and surfactant
B**: SIR 8514 and surfactant

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دراسات سميه على تأثير منظمات النمو الحشريه المنشطه بمادة ذات نشاط سطحى على بعض أطوار النمو للذبابه المنزليه موسكا دومستيكا.

فاتن فريد أبو الدهب

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تم معاملة العمر اليرقى الثالث للذبابة المنزليه باثنين من منظمات النمو الحشرية **BAY SIR 8514, SIR 8514** بالجرعات ٢٠، ٤٠، ٦٠، ٨٠، ١٠٠ جزء/ المليون ومركب التوين ٨٠ بتركيز ٢٪ لوحظ أن المادة ذات النشاط السطحى لها تأثير فعال على منظمات النمو الحشريه. لوحظ أن جميع المعاملات لها تأثير معنوى على النسبة المئوية لموت اليرقات. وعلى النقيض من ذلك لم يلاحظ أى تأثير معنوى على فترة نمو طور العذراء والنسبه المئويه للموت فى هذا الطور والسلوك التزاوجى للطور اليافع الناتج من المعاملة. ولوحظ تناقص معنوى فى كميه ماتضعه الأنثى من البيض. لوحظ أن اضافة المادة ذات النشاط السطحى (توين ٨٠) تزيد من النسبة المئويه للموت فى اليرقات، العذارى والطور اليافع وتناقص واضح فى عمر الاناث الناتجه من معامله العمر اليرقى الثالث بمنظمات النمو الحشرية المنشطة بمركب (توين ٨٠)، كما أن التناقص فى معدل ماتضعه الأنثى من بيض يعتمد على الجرعة المعطاة.